

CLAIMS

We claim:

1. A method for treating a chromatographic fluid, comprising:
providing a chromatographic fluid;
flowing the fluid through a short length of tubing to a column;
rapidly heating or cooling the fluid through the tubing;
measuring the temperature of the fluid through the wall of the tubing; and
using the measured temperature to control the rate of heating or cooling the fluid.
2. The method of claim 1, wherein the length of the tubing ranges from about 4 to about 36 inches.
3. The method of claim 2, wherein the length ranges from about 6 to about 12 inches.
4. The method of claim 1, wherein the tubing comprises a rapid heat transfer material.
5. The method of claim 1, wherein the rapid heating or cooling occurs at a rate up to about several hundred watts.
6. The method of claim 5, where the heating or cooling rate occurs at about 1 to about 100 watts
7. The method of claim 1, including measuring the temperature using a non-invasive procedure.
8. The method of claim 1, wherein the heating or cooling occurs upstream of the temperature measurement.
9. A method for treating a chromatographic fluid, comprising:
providing a chromatographic fluid;
flowing the fluid through a tube to a column, the tube having a length ranging from about 4 to about 36 inches;
heating or cooling the fluid through the tubing at a rate up to about several hundred watts;
measuring the temperature of the fluid through the wall of the tubing; and
using the measured temperature to control the rate of heating or cooling the fluid.
10. A method for treating a chromatographic fluid, comprising:
providing a short tube connected to a separation column;
providing heating or cooling means connected to a first portion of the tubing;

providing temperature-sensing means connected to a second portion of the tube closer to the separation column than the first portion;

flowing a chromatographic fluid through the tube;

modifying the temperature of the fluid using the heating or cooling means; and

sensing the temperature using the temperature sensing means.

11. The method of claim 10, further including providing temperature control means connecting the heating or cooling means and the temperature sensing means.

12. The method of claim 11, further including using the temperature control means to control the heating or cooling means.

13. The method of claim 10, wherein the length of the tubing ranges from about 4 to about 36 inches.

14. The method of claim 10, wherein the tubing is made of a rapid heat transfer material.

15. The method of claim 10, wherein the heating or cooling means modifies the temperature at a rate up to about several hundred watts.

16. The method of claim 10, wherein the temperature sensing means is non-invasive.

17. The method of claim 10, wherein the temperature modification occurs upstream of the temperature measurement.

18. An apparatus for treating a chromatographic fluid, comprising:

a short tube connected to a separation column;

low-mass heating or cooling means connected to a first portion of the tubing;

temperature-sensing means connected to a second portion of the tube closer to the separation column than the first portion; and

temperature control means connecting the heating or cooling means and the temperature sensing means.

19. The apparatus of claim 18, wherein the length of the tubing ranges from about 4 to about 36 inches.

20. The apparatus of claim 19, wherein the length of the tubing ranges from about 6 to about 12 inches.

21. The apparatus of claim 18, wherein the tubing comprises a rapid heat transfer material.

22. The apparatus of claim 18, wherein the heating means comprises a heater cartridge or heated wire adjacent the wall of the tube.

23. The apparatus of claim 18, wherein the cooling means comprises a peltier cooler or a cryogenic fluid.

24. The apparatus of claim 18, wherein the temperature-sensing means is a thermocouple or an RTD.

25. The apparatus of claim 18, wherein the heating or cooling means has a mass ranging from about 10 to about 200 mg.

26. A chromatography system comprising a device for treating a chromatographic fluid, the device comprising:

a short tube connected to a separation column;

low-mass heating or cooling means connected to a first portion of the tubing;

temperature-sensing means connected to a second portion of the tube closer to the separation column than the first portion; and

temperature control means connecting the heating or cooling means and the temperature sensing means.

27. The system of claim 26, wherein the length of the tubing ranges from about 4 to about 36 inches.

28. The system of claim 27, wherein the length of the tubing ranges from about 6 to about 12 inches.

29. The system of claim 26, wherein the tubing comprises a rapid heat transfer material.

30. The system of claim 26, wherein the heating means comprises a heater cartridge or heated wire adjacent the wall of the tube.

31. The system of claim 26, wherein the cooling means comprises a peltier cooler or a cryogenic fluid.

32. The system of claim 26, wherein the temperature-sensing means is a thermocouple or an RTD.

33. The system of claim 26, wherein the heating or cooling means has a mass ranging from about 10 to about 200 mg.